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Randomized Controlled Trial

The Efficiency of Manual Therapy and Sacroiliac and Lumbar Exercises in Patients with Sacroiliac Joint Dysfunction Syndrome

Aghalar Javadov, MD[1], Ayşegül Ketenci, MD[2], and Cihan Aksoy, MD[2]

From: [1]Department of Physical Medicine and Rehabilitation, Medicine Private Hospital Atlas University, Istanbul, Turkey; [2]Istanbul Faculty of Medicine, Istanbul University, Fatih, Turkey

Address Correspondence: Aghalar Javadov, MD Barbaros Hoca Ahmet Yasevi street, No: 149, 34203 Medicine Private Hospital, Gunesli, Bagcılar, Istanbul, Turkey 34203 Email: ajavadov1983@gmail.com

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Background: Manual therapy, exercise therapy, and the combination of these 2 are common treatments for sacroiliac joint dysfunction syndrome. The effects of these treatments have been discussed in several studies; the superiority of one over the other for patients with sacroiliac joint dysfunction syndrome is still the subject of discussion.

Objective: This study aims to assess the effects of manual therapy for sacroiliac joints, sacroiliac joints home-based exercises, and home-based lumbar exercises.

Study Design: A comparative, prospective, single-blind, randomized, controlled trial.

Setting: This trial was conducted at a single center at the Istanbul University, Istanbul Medical Faculty, Department of Physical Medicine and Rehabilitation.

Methods: Within the scope of this study, 69 women diagnosed with sacroiliac joint dysfunction syndrome through specific sacroiliac joints clinical diagnostic tests were randomized into 3 groups. The first group was assigned manual therapy and a sacroiliac joints home-based exercise program (n = 23), the second group was assigned sacroiliac joints manual therapy and a home-based lumbar exercise program (n = 23), and the third group was assigned a home-based lumbar exercise program (n = 23). All patients who participated in the study were evaluated at the beginning of the study and on the twenty-eighth and ninetieth day.

Results: All 3 groups showed a significant decrease in the sacroiliac joints -related pain parameter, which is checked with the visual analogue scale ($P < 0.05$) after the treatment. The Gillet test, Vorlauf test, Posterior Shear test, Compression test, and irritation Point tests after the treatment yielded a significant ($P < 0.05$) negative trend in all groups. Short Form-36 health survey for screening form, Modified Oswestry Pain Questionnaire, and Douleur Neuropathique 4 questions patient interview questionnaire for the assessment of neuropathic pain forms revealed a significant ($P < 0.05$) improvement in patients' complaints after the treatment in all 3 groups. Significant improvement in patients with sacroiliac joint dysfunction syndrome in all 3 groups was identified after the treatment.

Limitation: The absence of a healthy control group is one of the important limitations of the study.

Conclusions: Manual therapy is effective in the long term in sacroiliac joint dysfunction syndrome. Adding specific exercises for sacroiliac joints to the sacroiliac joints manipulation treatment further increases this effectiveness.

Key words: Sacroiliac joint, sacroiliac joint dysfunction syndrome, manual therapy, sacroiliac joint exercises, lumbar exercises

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Sacroiliac joint dysfunction syndrome (SIJDS) is a widely discussed source of lower back pain (1). Myriad authors underline that the sacroiliac joint (SIJ) is the source of pain in the lumbar vertebrae and femur region (2-5). SIJ can also be a nociceptive source in lower back pain (6-8).

The published prevalence of SIJDS in patients with chronic mechanic lower back pain (clinical examination, screening methods, and intraarticular test blockages) is between 16% and 30% (9). The studies report that the prevalence of SIJDS as the source of primary lower back pain was 0.4% in 1978, 35% in 1995, and 98% in 1992 (3,5). This discrepancy is explained by the lack of a valid criterion in the investigation of prevalence (3,10).

SIJDS is an often-overlooked part of the differential diagnosis of lower back and radicular pain (11-13). In the differential diagnosis, it is necessary to consider myofascial pain, fracture, discogenic pain, hip joint pathologies, osteoarthritis, avascular necrosis, zygapophysial joint pain, ankylosing spondylitis, rheumatoid arthritis, malignancy, visceral spreading pain, endometriosis, radiculopathy and pyriformis syndrome (9,14,15).

Gillet (Spina) test, Vorlauf test (standing flexion test or forward flow phenomenon), sitting flexion test, Derbolowsky test (switch from lying down to sitting), prone extension test, pelvic statics test, and others are motion palpation tests. Pain provocation tests, on the other hand, include, among others, Yeoman test, FABER (Patrick) test, compression test, distraction test, posterior shear test (POSH, 4P), sacral thrust, and Mennel's 3 stage extension test (16-18).

Diagnostic blocks are the golden standard in diagnoses. However, they must be interpreted carefully, for they may yield false positive and negative results. The best performance for the treatment of SIJ pain is observed in multidisciplinary approaches (9).

Medical therapy, resting, and ice therapy are recommended in the acute stage for treatment. In the subacute stage, manipulation and mobilization therapy, muscle energy techniques, kinesiotaping, stretching exercises, self-correction maneuvers, and strengthening exercises are recommended. In the chronic stage, SIJ exercises are recommended (12,19,20).

Even though pain complaints of patients could be due to a wide variety of reasons (mechanical, inflammatory, etc.), non-mechanical and nonfunctional pathologies, in particular, were not included in the study.

Patients diagnosed with recurring segmental dysfunction generally had a mechanical factor that would lead to dysfunction. Segmental dysfunctions are reversible, painful movement restrictions where signals transmitted via delta A and C fibers and sometimes via limbic system are collected by wide dynamic range (WDR) neurons. Through WDR neurons, autonomic nervous system, limbic system, and motor neurons are activated in the relevant segments reflexively. The main subject of manual medicine is the correction of segmental dysfunction, which presents itself with painful movement limitation and autonomic nervous system changes in a particular segment, with maneuvers that will not cause pain, but will help to correct the painful limitation of movement. On this theoretical basis, we intended improvement of pain and movement constraint with manual application which is shown to resolve segmental dysfunction in patients.

This study aimed to determine the effects of SIJ manipulation, sacroiliac and lumbar home exercises on pain, sacroiliac mobilization levels, and functional status in patients with SIJDS.

Methods

Planned as a prospective, single-blind, randomized, and controlled study, the interventional thesis study with a 3-month follow-up was conducted at a single center at the Istanbul University, Istanbul Medical Faculty, Department of Physical Medicine and Rehabilitation, between March 2017 and August 2017. A total of 69 patients who applied to the polyclinics of the Physical Medicine and Rehabilitation Department and were in accordance with the inclusion criteria of the study were included. The inclusion and exclusion criteria:

Inclusion criteria:

1) Women within the age range of 18 to 60
   (Men were not included in the study due to the fact that men and women tend to work in different sectors and the likelihood of sacroiliac dysfunction etiologies being different. Besides working at different lines of work, evaluation was made for a more homogenous group for labor, flexibility of ligaments, and hormonal properties, therefore, only women were selected. Women and men can be compared in another study and the difference among responses may be evaluated.)
2) According to the diagnostic criteria, recommended by the International Association for the Study of Pain (IASP):
   a. Patients with SIJ pain, pain in the SIJ region (hips/groins or may spread to lower extremity)

b. Pain that was felt in the SIJ region and could be revived with special provocation tests

3) Patients with a minimum of 3 positive results from among the 5 provocation tests that show sacroiliac joint dysfunction and the reliability-validity studies which have already been conducted:
   a. Vorlauf
   b. Gillet
   c. Irritation point positivity
   d. Posterior shear test (POSH)
   e. Compression
4) Those with a minimum of 3 points over the VAS scores for the sacroiliac pain in the past 1.5 months
5) Using no other nonsteroidal anti-inflammatory drugs during the therapy

Exclusion criteria:

1) Dislocation in the lower back and lower extremity, fractures
2) Acute disc hernia and spinal stenosis that may cause pain in the lower back and hips, piriformis syndrome
3) The existence of a known central nervous system or peripheral nervous system disease, the existence of a progressive neurological deficit
4) The existence of a known rheumatologic disease (rheumatoid arthritis, ankylosing spondylitis, and so on)
5) Prior major surgery for lower back and lower extremity (Surgeries may differ and impact regional stability. Therefore, manipulation may not be welcomed by patients and the majority of surgeons, even if other segments are stabilized.)
6) Pregnancy, lactation
7) The existence of known osteoporosis, metabolic diseases, severe cardiovascular disease, uncontrolled hypertension, severe renal diseases
8) The existence of malignancies
9) A VAS score of over 8 (on a scale of 0 – 10)
10) Having received manual therapy for the sacroiliac joint in the past 3 months

They were then randomized into 3 groups with computer software (quickcalc). The first group (manipulation + SIJ exercise group) was assigned SIJ manipulation and an SIJ home-based exercise program (n = 23); the second group (manipulation + L exercise group) was assigned SIJ manipulation and a home-based lumbar exercise program (n = 23), and the third group (L exercise group) was assigned lumbar exercises.

Physiatrists with a minimum of 4-year experience in making manual diagnosis and applying manual therapy referred the patients for the manual treatment. The interventions were performed by the same physician, Dr. Javadov, who had more than 4 years experience in manual therapy and completed a manual medicine-training program according to the Core Curriculum and the Guidelines for Basic Training and Education in Manual/Musculoskeletal Medicine issued by the International Federation for Manual/Musculoskeletal Medicine (FIMM; http://www.fimm-online.com). This way, it was aimed to prevent researcher bias.

First examinations after including the study group and all manipulations of all patients were carried out by one physician. Patients who finished the study were directed to referring to 2 physician respectively after final evaluation carried out by physician who performed treatment and second feedback was obtained from these two physician verbally.Two physicians involved in patient referral and the study (Prof Aksoy, Prof Ketenci) took part among the research. Acknowledgments were written to other referring physicians.

In the study, patients were evaluated by SIJDS via 5 tests: 2 SIJ motion palpation tests (Gillet test, Vorlauf test), SIJDS-specific provocation tests (compression, Posterior Shear), and SIJDS-specific irritation point positivity test (16-18). Visual analog scale (VAS) was used to evaluate the severity of SIJ pain in the study. In the study, MOPQ was used to evaluate the functional impairment of patients with SIJDS. In addition, SF-36 was used to assess the quality of life of the patients. In the study, neuropathic pain was evaluated by DN4-Patient Interview Questionnaire (21-23).

Adopted Interventions

Manual Therapy

One of the recommended treatment approaches for SIJDS in contemporary literature is manual therapy. This treatment involves manipulation and mobilization techniques.

Within the scope of this study, SIJ mobilization was carried out with the manipulation technique in the mobilization group in 3 sessions (one session a week for 3 weeks). At the beginning of the study and the end of the treatment (HTSD), on the twenty-eighth day (FA), and the ninetieth day (FA), SIJ-specific tests, SF-36, MOPQ, and the DN-4 questionnaire were used for evaluation. On day one, day 7, and day 14 before and after the treatment and on days 28 and 90, pain

severity was checked with a VAS scale for monitoring purposes. Sacroiliac manipulation was performed using manual treatment method by lying patients on their sides. First, the patient was positioned firmly on the edge of the examination table, while the restricted sacroiliac joint remains on the upper side. Then, the physician's hand was positioned on the patient's hip, and the flexion was made on the lumbar spine with the movement from the hip to the upper thigh, and the impulse given by the HVLA technique was applied in the anteroinferior direction to the iliac crest and trochanter major (Fig. 1).

Techniques of counterstrain/strain, myofascial release, or muscle energy all are efficient methods in resolving segmental dysfunction. However, clinical efficacy of HVLA applications for SIJ are not proven by studies in conformity with current scientific criteria and the current knowledge is not at a level to be evaluated in meta-analyses. We wanted to show the efficacy of this technique in particular with clinical and examination findings in the study. We also planned similar studies with different techniques and showing their efficacies singularly or in comparison with each other.

Fig. 1. *Position for high-velocity low-amplitude manipulation to sacroiliac joint with method by lying on its side*

Exercise Therapy

As a result of the studies, conducted to investigate the efficiency of exercise in SIJDS, patients were recommended SIJ correction exercises and lumbar stretching and strengthening exercises. The benefits and importance of exercise in controlling the symptoms were explained to all 3 groups in the study. Hands-on SIJ and lumbar exercises were taught to patients, followed by the assigning of special SIJ and lumbar exercises. Exercises must be conducted on the floor or ground. Each movement must be repeated 10 times every day, with 2 sessions per day. Each movement must take at least 10 seconds, and without hurrying, a 20-second break must be taken in between movements. Patients' breath should not be held. During the exercise, pain should be carefully approached. In instances when pain persists for over 20 minutes, exercise must be decreased or the movement causing the pain must be cut off. SIJ exercises included sacroiliac joint self-mobilization, piriformis stretch, glu-

teus medius and minimus stretch, gluteus maximus stretch, stretching the gluteal and piriformis muscles together, and hip muscle isometric strengthening exercises (pushing legs against each other on the pillow and pushing the legs out towards your hand). Lumbar exercises included knee to the same shoulder stretch, quadriceps stretch, hamstring stretch, posterior pelvic tilt, conventional back-bridge, conventional back-bridge with elevated one leg, and sit-up.

Data Analyses

Average, standard deviation, lowest and highest median, frequency, and ratio values were used for the descriptive statistics of the data. Distribution of variables was measured with the Kolmogorov Simirnov test. Kruskal-Wallis and Mann-Whitney U tests were used for the analysis of independent quantitative data. The Wilcoxon test was used for the analysis of dependent quantitative data. For the analysis of independent qualitative data, Chi-square test and Fischer test, when Chi-square test conditions were not provided, were used. The McNemar test was utilized for the analysis of dependent qualitative data. The analyses were carried out using the SPSS 22.0 program.

Results

A total of 69 women were included in the study, who were later divided into 3 groups: SIJ manipulation + SIJ exercise group (Group 1) (n = 23), SIJ manipulation + lumbar exercise group (Group 2) (n = 23), and lumbar exercise group (Group 3) (n = 23). The study was completed with the same number of patients (Fig. 2). No patient drop-out occurred in our study. This can be explained by the tolerable and effective technique we applied and satisfactory preliminary information. In addition to this, Istanbul University, Physical Medicine and Rehabilitation Department, is a well-known center, with many references and it is one the most competent clinics that focuses on lumbar pain.

The ages of the 69 patients ranged from 18 to 60, while the average age of Group 1 is 32.8 ± 6.7, that of Group 2 was 36.2 ± 9.1, and that of Group 3 is 36.9 ± 9.6 (Table 1).

The investigation of the painful side of the patients showed that 47.8% (n = 11) of the patients in Group 1 described pain in their right SIJ and 52.2% (n = 12) described pain in their left SIJ. In Group 2, 43.5% (n = 10) of the patients described pain in their right SIJ, and 56.5% (n = 13) described pain in their left SIJ. Finally, 47.8% (n = 11) of the patients in Group 3 had pain in their right SIJ, and 52.2% (n = 12) had pain in their left SIJ. No statistically significant differences were observed among the groups with respect to the painful side ($P = 0.943$; $P > 0.05$) (Table 1).

Regarding all 5 tests positive on day 1, there was no significant difference between Group 1, Group 2, and Group 3 ($P > 0.05$). Most of the 5 tests that Group 1 was positive on the twenty-eighth to ninetieth days were significantly lower than Group 2 and Group 3 ($P < 0.05$). Finally, most of the 5 tests that were Group 2

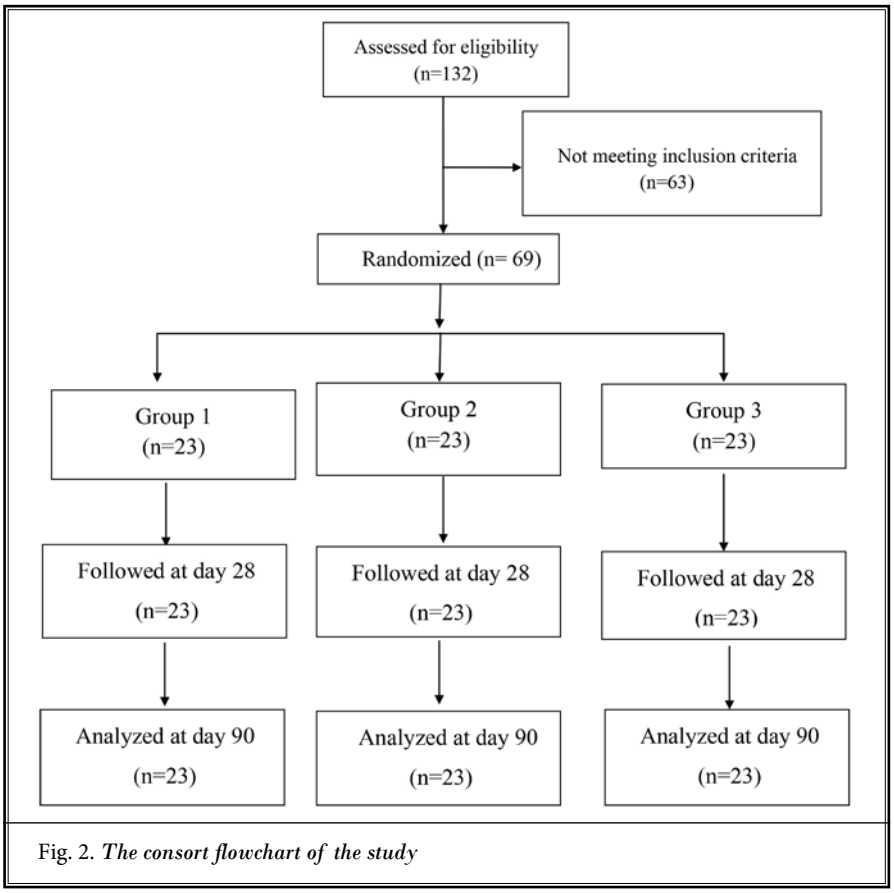

Fig. 2. *The consort flowchart of the study*

Table 1. *Distribution of demographics among three groups*

		Group I		Group II		Group III		*P*
		Mean ± SD /n-%	Med	Mean ± SD /n-%	Med	Mean ± SD /n-%	Med	
Age		32.8 ± 6.7	36.0	36.2 ± 9.1	40.0	36.9 ± 9.6	40.0	0.093[K]
BMI		23.3 ± 4.2	22.3	23.7 ± 3.4	23.2	24.7 ± 4.4	23.7	0.486[K]
Duration of pain		25.2 ± 12.8	21.0	25.5 ± 10.0	28.0	25.2 ± 11.2	27.0	0.997[K]
Occupation								
Housewife		2 (8.7)		2 (8.7)		3 (13.0)		0.506[X2]
Desk job		6 (26.1)		8 (34.8)		11 (47.8)		
Physical job		15 (65.2)		13 (56.5)		9 (39.1)		
Number of births	0	18 (78.3)		14 (60.9)		11 (47.8)		0.102[X2]
	I	4 (17.4)		4 (17.4)		4 (17.4)		
	II	1 (4.3)		3 (13.0)		7 (30.4)		
	III	0 (0.0)		2 (8.7)		1 (4.3)		
Standing time 6 hours >	(-)	11 (47.8)		11 (47.8)		12 (52.2)		0.944[X2]
	(+)	12 (52.2)		12 (52.2)		11 (47.8)		
Side of pain	Right	11 (47.8)		10 (43.5)		11 (47.8)		0.943[X2]
	Left	12 (52.2)		13 (56.5)		12 (52.2)		

[K] Kruskal-wallis (Mann-whitney u test) / x^2 Chi-square test, Sd=Standard deviation, Med=median.

positive on the twenty-eighth to ninetieth days were significantly lower than Group 3 ($P < 0.05$) (Table 2).

Group 1, Group 2, and Group 3 did not show a significant ($P > 0.05$) difference on day 1 in MOPQ. MOPQ scores for Group 1 on the twenty-eighth and ninetieth days were significantly ($P < 0.05$) lower than Group 2 and Group 3 (Table 3).

DN-4 value of Group 1, Group 2, and Group 3 on day 1 and day 28 did not show any significant ($P > 0.05$) differences. The DN-4 score of Group 1 on the ninetieth day was significantly ($P < 0.05$) lower than Group 2 and Group 3. The DN-4 score of Group 2 on the ninetieth day, on the other hand, was significantly ($P < 0.05$) lower than Group 3 (Table 3).

A comparison of all 3 groups reveals that the SF-36 physical function score before the treatment was similar in all 2 groups. The SF-36 physical function score of Group 1 on the twenty-eighth day and the ninetieth day were significantly ($P < 0.05$) higher than Group 2 and Group 3. Between Group 2 and Group 3, no significant ($P > 0.05$) differences were observed with respect to the SF-36 physical function score on the twenty-eighth day and the ninetieth day (Table 3).

VAS Pain Severity Scale (Resting Pain)

A comparison of the 3 groups revealed that the groups were homogeneous at first in terms of resting pain. All assessments of Group 1 showed that the resting VAS score was significantly ($P < 0.05$) lower than Group 2 and Group 3. In Group 2 and Group 3, on the other hand, the resting VAS score did not show a significant ($P > 0.05$) difference on the seventh day. The resting VAS score of Group II on the fourteenth, twenty-eighth, and ninetieth days were significantly ($P < 0.05$) lower than Group 3 (Table 4).

A comparison of the 3 groups revealed that the groups were homogeneous at first. In all assessments, the movement VAS score of Group 1 after the treatment was significantly ($P < 0.05$) lower than Group 2 and Group 3. The movement VAS score on the seventh day for Group 2 and Group 3 did not show any significant differences ($P > 0.05$). Furthermore, on the fourteenth, twenty-eighth, and ninetieth days, the movement VAS Score of Group 2 was significantly ($P < 0.05$) lower than Group 3 (Table 4).

Discussion

As a result of manual therapy and home-based exercise treatment approaches for SIJ in patients with SIJDS, all 3 groups revealed a significant decline in pain parameters of SIJ region pain and SIJ-related activities.

Bernard and Cassidy (26) report in their study that they treated 258 patients with SIJD with manipulation and acquired significant results that showed improve-

Table 2. *Comparison of Gillet test, Vorlauf test, I. Point test and POSH test between 3 groups*

		Group I		Group II		Group III		*P*
		n	%	n	%	n	%	
Gillet Test								
Day 0	(-)	1	4.3	1	4.3	0	0.0	$P > 0.05^X$
	(+)	22	95.7	22	95.7	23	100	
Day 28	(-)	22	95.7	16	69.6	13	56.5	0.009^X
	(+)	1	4.3	7	30.4	10	43.5	
Change acc. to Day 0 *P*		$< 0.001^N$		$< 0.001^N$		$< 0.001^N$		
Day 90	(-)	23	100	20	87.0	11	47.8	$< 0.001^X$
	(+)	0	0.0	3	13.0	12	52.2	
Change acc. to Day 0 *P*		$< 0.001^N$		$< 0.001^N$		0.001^N		
Vorlauf test								
Day 0	(-)	0	0.0	0	0.0	1	4.3	$P > 0.05^X$
	(+)	23	100	23	100	22	96	
Day 28	(-)	22	95.7	16	69.6	8	34.8	$< 0.001^X$
	(+)	1	4.3	7	30.4	15	65.2	
Change acc. to Day 0 *P*		$< 0.001^N$		$< 0.001^N$		0.016^N		
Day 90	(-)	23	100	19	82.6	9	39.1	$< 0.001^X$
	(+)	0	0.0	4	17.4	14	60.9	
Change acc. to Day 0 *P*		$< 0.001^N$		$< 0.001^N$		0.008^N		
I. Point Test								
Day 0	(-)	0	0.0	0	0.0	0	0.0	NSA
	(+)	23	100	23	100	23	100	
Day 28	(-)	22	95.7	17	73.9	9	39.1	$< 0.001^X$
	(+)	1	4.3	6	26.1	14	60.9	
Change acc. to Day 0 *P*		$< 0.001^N$		$< 0.001^N$		0.004^N		
Day 90	(-)	23	100	21	91.3	14	60.9	0.001^X
	(+)	0	0.0	2	8.7	9	39.1	
Change acc. to Day 0 *P*		$< 0.001^N$	^{N}	$< 0.001^N$		$< 0.001^N$		
POSH Test								
Day 0	(-)	4	17.4	9	39.1	10	43.5	0.132^X
	(+)	19	83	14	61	13	57	
Day 28	(-)	20	87.0	17	73.9	13	56.5	0.063^X
	(+)	3	13.0	6	26.1	10	43.5	
Change acc. to Day 0 *P*		$< 0.001^N$		0.008^N		0.375^N		
Day 90	(-)	21	91	18	78.3	14	60.9	0.049^X
	(+)	2	8.7	5	21.7	9	39.1	
Change acc. to Day 0 *P*		$< 0.001^N$		0.004^N		0.219^N		

^{X} Chi-square test / ^{N} McNemar test, NSA=Not Suitable for Analysis

ment in 95% of the patients. However, this study does not report long-term follow-up results. Therefore, the extent to which complaints return after manipulation is not known.

In Osterbrauer et al (25), on the other hand, 10 patients with SIJDS were treated with short lever-type manipulation 3 times a week for 5 weeks, and after a one-year follow-up, 6 patients were observed to maintain their well-being.

Herzog et al (24), on the other hand, applied

Table 3. *Comparison of Modified Oswestry Scale, DN-4 and SF-36 Physical Function scores between the three groups*

	Group I		Group II		Group III		*P*
	Mean ± SD	Med	Mean ± SD	Med	Mean ± SD	Med	
Modified Oswestry Scale							
Day 0	31.6 ± 14.2	34.2	45.1 ± 15.4	41.0	35.1 ± 13.2	33.0	0.055[K]
Day 28	14.2 ± 9.7	11.7	27.7 ± 13.4	29.4	27.5 ± 15.0	24.0	0.001[K]
Change acc. to Day 0 *P*	< 0.001[w]		< 0.001[w]		0.001[w]		
Day 90	7.0 ± 5.3	7.1	19.7 ± 13.9	15.6	26.4 ± 15.3	23.5	< 0.001[K]
Change acc. to Day 0 *P*	< 0.001[w]		< 0.001[w]		0.003[w]		
DN-4							
Day 0	1.5 ± 1.2	1.0	2.0 ± 1.1	2.0	1.5 ± 1.2	1.0	0.277[K]
Day 28	0.5 ± 0.7	0.0	1.2 ± 1.3	1.0	1.0 ± 1.1	1.0	0.167[K]
Change acc. to Day 0 *P*	< 0.001[w]		0.003[w]	w	0.019[w]		
Day 90	0.2 ± 0.5	0.0	0.7 ± 0.9	0.0	1.4 ± 1.0	1.0	< 0.001[K]
Change acc. to Day 0 *P*	< 0.001[w]		0.001[w]		0.771[w]		
SF-36 Physical Function							
Day 0	75.0 ± 15.4	65.0	57.4 ± 26.2	55.0	59.6 ± 21.9	60.0	0.062 [K]
Day 28	84.6 ± 12.2	90.0	73.3 ± 19.2	75.0	75.2 ± 14.9	80.0	0.039[K]
Change acc. to Day 0 *P*	0.003[w]		0.002[w]		< 0.001[w]		
Day 90	90.9 ± 8.6	90.0	80.2 ± 21.2	85.0	75.9 ± 16.7	75.0	0.002[K]
Change acc. to Day 0 *P*	< 0.001[w]		0.001[w]		0.002[w]		

[K] Kruskal-wallis (Mann-whitney u test) / [w] Wilcoxon test, SD=Standard deviation, Med=Median

manipulation to 11 patients with SIJD 3 times with 2 weeks between each session. While the well-being of patients was maintained in the majority of the patients according to pain, joint motion, and Oswestry assessment scales, some of the patients reported an increase in their pain levels in the first 2 weeks (26).

In Koes et al (27), manipulation and mobilization techniques were used in a group, and physiotherapy, exercise, and massage techniques were used together in another group, medication was given to yet another group, and a placebo was given to the final one. Among all these groups, no significant differences were observed when global activity evaluation, pain, and functional scale scores were checked.

In a meta-analysis, combined chiropractic applications were observed to be effective on pain and disability in acute and sub-acute lower back pain (28).

In a thesis study by Sezgin (17), where patients with SIJD were assigned manual therapy and exercise treatment, 2 groups of patients with 30 patients in each group (Group 1 received SIJ exercises + mobilization and Group 2 received SIJ exercises only) were provided treatment randomly. There are very little if any, studies that are similar to our study. Since Sezgin's study as mentioned above is the closest one to our research, it was specifically compared to the current results with it.

In Sezgin's study (17), no significant differences were found between mobilization and exercise groups in the post-treatment follow-ups with respect to pain control, physical examination findings, and MOPQ.

In our study, on the other hand, all 3 groups revealed significant improvement in the resting and movement VAS pain scale and physical examination findings (Gillet, Vorlauf, and irritation point test). Overall, the groups that received manipulation had the best results, while SIJ exercises were found to be more effective than lumbar exercises. In the MOPQ form, all 3 groups showed significant improvement. The results of Group 1 showed more significant improvement than those of Group 2 and Group 3, while no significant difference arose between the other 2 groups.

The assessment of the groups also included a compression test. Its results did not yield any significant differences in all 3 groups. This can be explained as follows: the compression test is often used on patients with sacroiliitis and is positive for them. Pain provocation on joint motions by lying down on one side and applying pressure on SIJ is rather challenging in SIJDS due to the distortion in nutation or counter nutation

Table 4. *Comparison of VAS pain scale scores by groups*

	Group I			Group II			Group III			*P*
	Mean ± SD		Med	Mean ± SD		Med	Mean ± SD		Med	
VAS Resting										
Resting Pain										
Day 0	4.1 ± 1.2		4.0	4.8 ± 1.0		5.0	4.8 ± 1.1		5.0	0.065[K]
Day 7	2.5 ± 1.2		2.0	3.4 ± 1.3		4.0	3.8 ± 1.2		4.0	0.006[K]
Change acc. to Day 0 *P*		< 0.001[W]			< 0.001[W]			< 0.001[W]		
Day 14	1.6 ± 1.0		2.0	2.6 ± 1.5		2.0	3.3 ± 1.2		3.0	< 0.001[K]
Change acc. to Day 0 *P*		< 0.001[W]			< 0.001[W]			< 0.001[W]		
Day 28	0.6 ± 0.7		1.0	2.3 ± 1.6		2.0	3.4 ± 1.4		3.0	< 0.001[K]
Change acc. to Day 0 *P*		< 0.001[W]			< 0.001[W]			< 0.001[W]		
Day 90	0.1 ± 0.3		0.0	1.3 ± 1.4		1.0	3.1 ± 1.7		3.0	< 0.001[K]
Change acc. to Day 0 *P*		< 0.001[W]			< 0.001[W]			< 0.001[W]		
VAS Motion										
Motion Pain										
Day 0	5.8 ± 1.0		6.0	6.1 ± 1.1		6.0	5.9 ± 1.0		6.0	0.439[K]
Day 7	3.8 ± 1.3		4.0	4.5 ± 1.4		5.0	5.1 ± 1.2		5.0	0.007[K]
Change acc. to Day 0 *P*		< 0.001[W]			< 0.001[W]			< 0.001[W]		
Day 14	2.6 ± 1.4		3.0	3.7 ± 1.8		4.0	4.6 ± 1.3		5.0	< 0.001[K]
Change acc. to Day 0 *P*		< 0.001[W]			< 0.001[W]			< 0.001[W]		
Day 28	1.2 ± 1.1		1.0	3.3 ± 2.1		3.0	4.4 ± 1.4		4.0	< 0.001[K]
Change acc. to Day 0 *P*		< 0.001[W]			< 0.001[W]			< 0.001[W]		
Day 90	0.4 ± 0.7		0.0	1.9 ± 1.7		2.0	4.1 ± 1.7		4.0	< 0.001[K]
Change acc. to Day 0 *p*		< 0.001[W]			< 0.001[W]			< 0.001[W]		

[K] Kruskal-wallis (Mann-whitney u test) / [w] Wilcoxon test, Sd=Standard deviation, Med=median.

movements in SIJDS. At the same time, the test sometimes yields false positives, since there is pressure on the trochanteric bursa and hip joint.

In Ulger et al (29), 113 patients with chronic lower back pain were randomly distributed to 2 groups and received manual therapy (manipulation, mobilization, muscle energy techniques) or exercises (core stabilization). Patients were assessed before and after the treatment; while improvement in both groups was determined, the manual therapy group was reported to yield better results.

In a prospective study of Kamali and Shokri (30), 32 women diagnosed with SIJDS were evaluated with VAS and MOPQ immediately after treatment, after 48 hours and one month after SIJ manipulation. As a result, significant improvement in pain and functional status has been reported.

In Nejati et al (31), 51 patients with SIJD, were randomly distributed to 3 groups: exercise treatment (ET), manual therapy (MT), and both of treatment (EMT). The ET group received SIJ correcting and spinal stabilization exercises. The MT group received SIJ manipulation and mobilization. The EMT group received SIJ manipulation maneuvers and exercise therapy. Disability and pain were evaluated at 6, 12, and 24 weeks after the treatments. A significant improvement in pain and functional status in all groups for 24 weeks was reported as a result. The therapeutic effect of manual therapy appeared in week 6, but exercise treatment, in improving functionality proved more effective at week 12. Finally, no significant differences were observed among the groups at week 24 (31). However, in the current study, on the twenty-eighth and ninetieth days, in the Group 1 and Group 2, which treatments consist of sacroiliac manipulation and exercises, got better results than Group 3, which treatment was only exercises.

In Feeney et al (32) showed that SIJD involves reduced coactivation of the gluteus maximus and contralateral latissimus dorsi, which during walking,

these 2 muscles together provide joint stability. In this study, a group, which consists of 6 women with unilateral SIJD, walked on a force-measuring treadmill at one m/s. At the same time, they recorded with surface EMG, kinematics, and the activity of 16 muscles. The results indicated that patients with SIJD exhibited both reduced activations of gluteus maximus during a loading synergy present in walking and greater asymmetry between legs.

It is thought that a rehabilitation program with specific exercises for SIJ and lumbar areas, used in the study, not only decrease pain but also may strengthen the gluteus maximus and latissumus dorsi, and mobilize SIJ, and can contribute to stabilization of muscles in this area and as a result improve walking.

In Kamali et al (31), 40 patients with SIJD were assigned manual therapy (M) and exercise treatment (S), 2 groups of patients with 20 patients in each group were provided treatment randomly (in each group 15 patients received treatment). The treatment program in Group M lasted 2 weeks and 4 weeks in Group S. The Oswestry Disability Index (ODI) and pain index were recorded before and after the treatment. The improvements were seen in both groups after the treatment, but no significant differences were observed between 2 groups. Nevertheless, in our study, both groups treated with manual therapy and exercises got better results than the group treated with exercises only. It was thought that the reason why the results of our study are different from this study, may be that we was used a combination of manual therapy and exercises treatment. On the other hand, although the ODI score changes were smaller in our study, a decrease in pain and disability was found in the manipulation group. The reason why the results of our study are different from Kamali's study, may have been the longer duration of therapies used in our study.

No similar, comprehensive, randomized study investigating SIJD originating from SIJ has been found in the literature search. In addition, there are very few studies comparing the effectiveness of manual therapy and home exercise therapy for the SIJ in patients with SİJD. The fact that the demographic features of the study, such as preferred age, body mass index, marital status, educational status, and judgment status are homogeneous among the groups is another strong feature of the study.

The absence of a healthy control group is one of the important limitations of the study. Another limitation of this study is the short follow-up period.

Even though the number of patients in the study are statistically sufficient, the study could be multicentric, with more patients. However this would be an application that could affect the manipulation technique and may make interpretation of results more difficult. Excluding men is also a restriction and reduced the number of patients.

Conclusions

It was inferred from the study that a combination of manual therapy and exercise therapy is more efficient than exercise therapy only in patients with SIJDS. Specific exercise programs for SIJ with manual therapy especially yield even more efficient results.

Ethical Approval

This study was approved by the Ethics Committee of the Istanbul University Faculty of Medicine (IRB study protocol: 2016/1291).

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